

2012 Instream Flow Recommendations for the Spokane River

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Summary

The recommended minimum instream flows for the Spokane River as measured at the “Spokane River at Spokane” gage (USGS 12422500) in cubic feet per second (cfs) over the water year are:

October 1 – March 31	1,700 cubic feet per second (cfs)
April 1 – June 15	6,500 cfs
June 16 – September 30	850 cfs

The “Spokane River at Spokane” gage will be the control point for the minimum instream flows to regulate junior surface water withdrawals from Sullivan Road Bridge downstream to Seven Mile Bridge, and to regulate junior ground water withdrawals within the Washington portion of the Spokane Valley-Rathdrum Prairie Aquifer.

Flows in the Spokane River between the state line and Sullivan Road are largely determined by the instream flow conditions for Avista’s Post Falls Hydroelectric Project (FERC 2545), including the interim 500 cfs minimum flow as measured at the Post Falls gage (USGS 12419000). That flow corresponds naturally to a flow of 350 cfs as measured at Barker Road (USGS 12420500), but the adopted watershed management plan recommended 500 cfs at Barker Road. Any new surface water rights issued between the state line and Sullivan Road Bridge could impair instream flows and resources in this reach; therefore, any rights issued in this reach of the Spokane River should be curtailed at such flows. I recommend a minimum instream flow for junior surface water withdrawals out of the Spokane River between the state line and Sullivan Road Bridge of 500 cfs as measured at the Barker Road gage (USGS 12419000) during the period June 16 through September 30. This gage is currently not telemetered.

Introduction

Instream flows should address what the river needs to preserve its values and resources and ecological functions. Recommendations are based on site-specific studies, weighting the most appropriate data most heavily, and on the natural flow paradigm (Poff, et al. 1997), which states that the natural timing and range of variation in hydrology is needed to sustain ecological functions and processes in a river. The natural flow paradigm does not provide explicit instream flow recommendations. It provides a general principle.

When there is uncertainty, the state recognizes that any water rights will be issued in perpetuity so instream flows should be protective and conservative. There is no harm to the river from being conservative, but it is hard to undo harm if instream flows are not protective enough and water is appropriated down to the instream flow.

Fish are one of many instream resources that are protected by instream flows. Native fish have survived natural flows for thousands of years. We should be very cautious about expectations of improvement (increased fish production) through flow reduction. Where several species and life stages coexist, all must be considered. Much like the physicians' rule, "First, do no harm," we need to consider individual responses and avoid conditions that sharply reduce habitat for any one species or life stage or stream segment.

Spokane River Fish Community

The fish community of the lower Spokane River (downstream from Spokane Falls) consists of about 39 species of which 18 are native (Wydoski and Whitney 2003). Of the 18 native fish species, 11 are species associated with strong current and flow. These include the species with the greatest biomass, mountain whitefish (*Prosopium williamsoni*), and rainbow or redband trout (*Oncorhynchus mykiss*). Other larger fish included in this group are westslope cutthroat trout (*O. clarki lewisi*), bull trout (*Salvelinus confluentus*), longnose sucker (*Catostomus catostomus*), and bridgelip sucker (*C. columbianus*); smaller species include several sculpins (*Cottus bairdii* and *C. rhotheus*) and dace (*Rhinichthys cataractae* and *R. osculus*).

In developing instream flow recommendations for the lower Spokane River, the Washington Department of Fish and Wildlife (WDFW), in cooperation with Department of Ecology (Ecology), has emphasized rainbow trout and mountain whitefish. Rainbow trout are important native sport fish in the Spokane River and their habitat needs are similar to those of the other trout. Mountain whitefish make up the majority of larger fish in the river and have similar habits and habitat requirements to the suckers, which are found with whitefish. Mountain whitefish also provide a winter recreational fishery when trout are not feeding as actively as whitefish. Both rainbow trout and mountain whitefish feed actively through the summer and fall. Whitefish spawn in the fall. Rainbow trout spawn in the spring.

Results of several studies (EES Consulting 2007, NHC and HD 2004, Parametrix 2003a,b, Addley and Peterson 2011) provide information on trout and whitefish habitat at different flows and different seasons in the lower Spokane River. The EES Consulting (2007) study presents relationships between flow and fish habitat in terms of weighted usable area (WUA). WUA is a standard index that combines habitat quantity and quality in instream flow studies. WUA is based on observed fish preferences for depth, velocity, and bed material (e.g., mud, sand, gravel, cobble, boulder, bedrock) at different life stages. Habitat preferences are based on comparison of where fish are observed (when undisturbed) and what habitat is available to them. WDFW

has revised the 2010 seasonal flow recommendations to incorporate the new information from the Addley and Peterson study and to integrate a re-evaluation of the EES, NHC and HD, and Parametrix studies.

Seasonal Flow Recommendations and Rationale

Flow recommendations and rationale will be presented by season. Where instream flows are based on WUA, they are weighted 80% by results from the Gun Club site representing WRIA 54, and 20% by results from the WRIA 57 study site as analyzed from the EES Consulting (2007) report. These weighted percentages were selected because 80% of the study transects were located in WRIA 54, and 20% were located in WRIA 57. The WRIA 57 site only represents that portion of the Spokane River in WRIA 57 between Spokane Falls and the confluence of Latah/Hangman Creek (where WRIA 57 ends and WRIA 54 begins).

Summer minimum instream flows: June 16-September 30

The upper part of the Spokane River (entirely within WRIA 57) is heavily influenced by Avista's operation of Post Falls Dam according to conditions in the Federal Energy Regulatory Commission (FERC) license #2545. License conditions include instream flow releases at Post Falls. Those flows equate to flows at the Barker Road gauge (Spokane River at Greenacres, WA USGS 12420500). These flows are subject to adaptive management to balance instream physical habitat, as measured by WUA (NHC and HD 2004), and temperature suitable for trout; adaptive management and monitoring are described in the Spokane River Water Temperature and Discharge Flow Monitoring Plan, dated May 11, 2010. To avoid impairment of instream resources and to be consistent with Recommendation II.A.01.a in the Watershed Management Plan (Little Spokane River and Middle Spokane River Planning Unit, 2006: p.63), junior surface water withdrawals out of the Spokane River from the state line to Sullivan Road Bridge should be interruptible at flows protective of in stream resources: 500 cfs as measured at the Barker Road gage during the period June 16 through September 30.

Summer is a season of lower flows and warmer temperature. Newly emerged trout fry inhabit abundant shallow water with low to moderate current velocity. Juvenile and adult fish are more active with higher temperature. This higher metabolic activity means more vigorous feeding and greater need for caloric intake. Adult trout are territorial, chasing away other fish that enter their territories, so suitable habitat is at a premium.

The weighted combination of rainbow trout and whitefish WUA peaked at 900 cfs. This was 87% of the maximum rainbow trout WUA (peak at 400 cfs) and 89% of maximum whitefish WUA (peak at 1,700 cfs, Figure 1). To achieve similar WUA levels for both species (about 88%

of peak WUA), a flow of 850 cfs should be protected. Thus, we recommend 850 cfs as the summer (June 16-September 30) instream flow measured at the “at Spokane” gage.

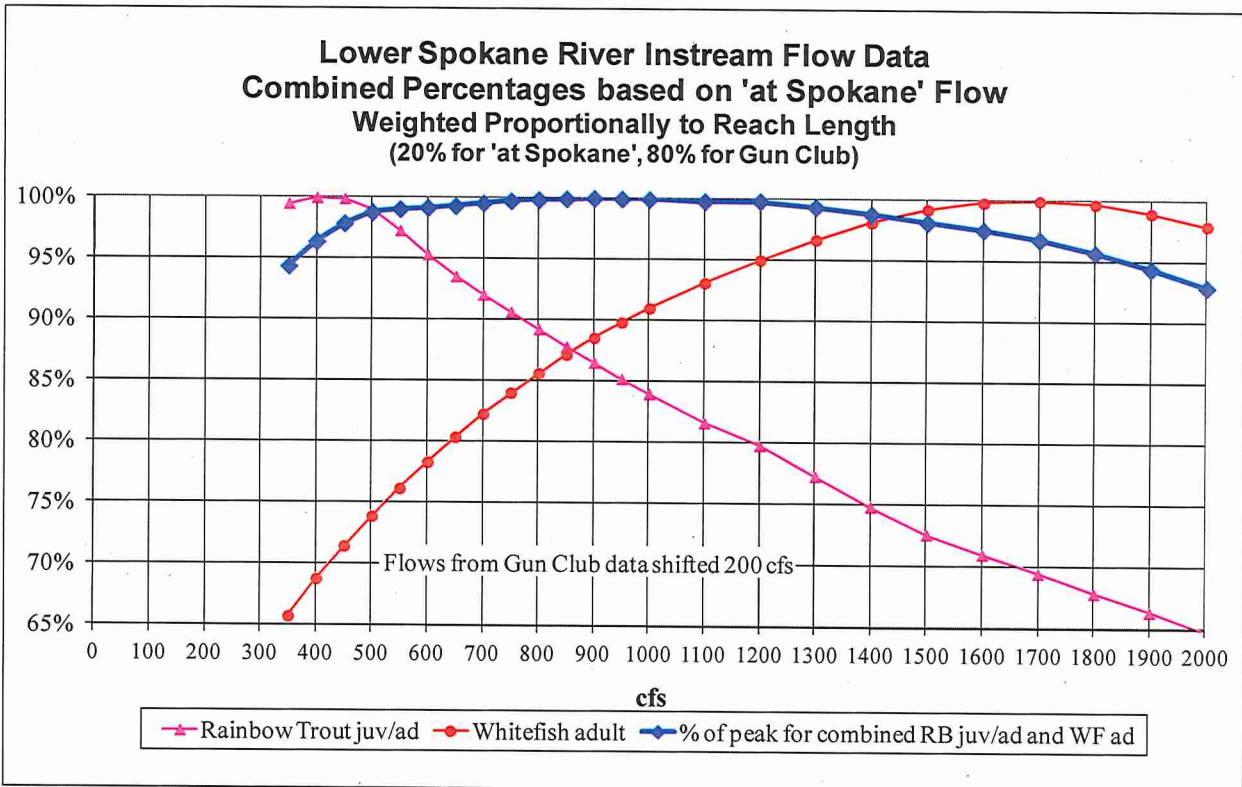


Figure 1. Modeled relationship between fish habitat (WUA) and flow in the lower Spokane River as determined by EES Consulting (2007) in a study commissioned by the Watershed Planning Unit. Juvenile and adult rainbow trout WUA, mountain whitefish WUA, and a combination of the two species were graphed in terms of percent maximum WUA. These relationships were used for recommending summer instream flow.

Fall and winter minimum instream flows: October 1-March 31

In fall and winter (October 1-March 31), we prioritized whitefish over rainbow trout with a minimum instream flow of 1,700 cfs. Rainbow trout juvenile and adult WUA were analyzed with whitefish for fall and winter, rather than using only winter rainbow trout WUA because while rainbow trout juvenile and adult response is appropriate through October and some of November, rainbow trout winter fish habitat criteria were developed in small, steep mountain streams and are not directly applicable to the Spokane River. Rainbow trout winter WUA peaked at the lowest flow modeled (350 cfs). Alternatively, whitefish spawning peaked near 1,700 cfs (Figure 2) in the lower river and occurs as a fall behavior. In winter, rainbow trout have lower metabolic rates and tolerate more crowding than when they are active, thus the risks

to rainbow trout by experiencing natural winter stream flows is not great. We do not believe that winter flow-dependent habitat is a major limiting factor for rainbow trout in the Spokane River, nor that decreasing winter stream flows would result in significant benefits for trout. The winter instream flow thus emphasizes protection of whitefish spawning.

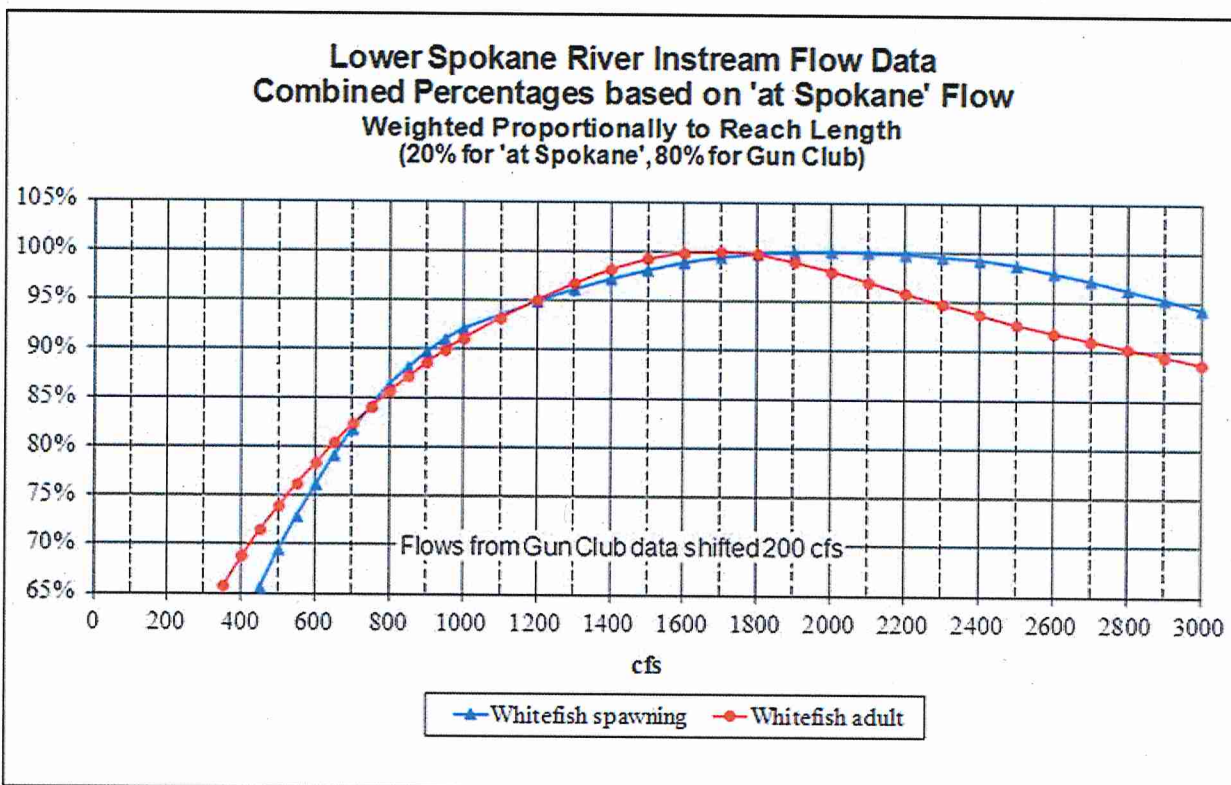


Figure 2. Modeled relationship between habitat (WUA) for whitefish spawning and adult and flow in the lower Spokane River as determined by EES Consulting (2007) in a study commissioned by the Watershed Planning Unit. The modeled relationship is weighted 80% for the Gun Club site (WRIA 54) and 20% for the WRIA 57 site.

Mountain whitefish support a sport fishery during winter. They feed actively in winter. They are the most numerous fish in larger streams in Washington, including the Spokane River. Consequently, WDFW emphasizes mountain whitefish winter habitat in recommending winter flows. Whitefish adult WUA peaks at 1700 cfs (Figure 2), and therefore WDFW recommends 1700 cfs as a suitable instream flow during winter months.

During fall and winter rainbow trout are less active, less territorial, and more tolerant of crowding when temperature drops below 6-8°C (43-46 °F). They spend daylight hours burrowed

among cobbles and are visible to a diver only if the diver moves the cobble. At night they swim and feed in slow water, moving slowly as their metabolism tracks the temperature to a low level. Because of their low metabolic rate and tolerance of crowding, rainbow trout in winter use less habitat than in summer. Although modeled habitat (WUA) peaks at low flows, rainbow trout populations survive lower winter WUA in most Washington streams, and WDFW does not emphasize them as much as mountain whitefish. In most Washington streams higher flows that are suitable for mountain whitefish do not appear to adversely impact rainbow trout.

Spring minimum instream flows: April 1 to June 15

Spawning and incubation are important to continued populations of rainbow trout in the Spokane River and could be adversely impacted by lowering of the flow during spawning and incubation seasons (spring). The combination of localized concentration of spawning and apparent flow sensitivity of spawning and incubation suggest that reproduction may be a significant limiting factor for the lower Spokane River trout population. Natural and artificial discontinuities in the Spokane River mean that each reach of river must have suitable spawning and incubation habitat in order to support a self-sustaining trout population. Spawning habitat should be protected so that the frequency with which it is usable at the appropriate season does not decrease. Protection of spawning habitat includes protection of incubation.

Rainbow trout in the Spokane River begin spawning when they are 3 years old, when a female can spawn several hundred eggs. With each succeeding year females have more eggs, perhaps 1500 by age 6. Thus, there can be 4 year-classes that spawn most years. Even though not all survive from one year to the next, the increasing fecundity makes up for some of the attrition with age. Because they have long life (about 6 years) and can spawn each year once they are mature, the population can survive occasional bad years or even short strings of unfavorable spawning years and have the ability to produce enough offspring under favorable conditions so that the population can rebound.

In the Spokane River, rainbow trout spawn in April in gravel and small cobble with moderate water velocity and depth. Addley and Peterson (2011: Figure 5) found new trout redds that indicated spawning peaked April 15-28 in 2010 at about 6,000 cfs, with some spawning earlier and later (early May). The trout bury the eggs in a gravel nest or redd, where the eggs incubate and develop into June, when they hatch and the fry emerge. Fry are about an inch long, with minimal swimming ability, so they cannot tolerate high velocity when they emerge (although they are small enough at emergence that they can shelter among the gravel). Shallow water at the time of emergence protects them from larger aquatic predators, primarily fish, but absence of water dooms them. The main emergence period was early June as identified by Addley and Peterson (2011: section 6.3.1); this timing for spawning and emergence is generally consistent with timing identified by Chris Donley (WDFW) early in discussions of Spokane River flows and with timing considered by Hardin (NHC and HD 2004). The redd must remain wetted

through the time the fry emerge. If water level drops below the level of the redd for too long the eggs will die. The redd must have water over the top of it when the fry emerge.

Spawning and incubation conditions are not ideal every year in the Spokane River, and they are sometimes very poor. For example, in six (1977, 1980, 1987, 1992, 1994, 2001) out of 31 years (1977-2007) flows during the first half of April and the first half of June were so low that reproduction may have failed, based on two sites analyzed by NHC and HD (2004) and Parametrix (2003a, b). The most thorough lower Spokane River rainbow trout spawning flow study was conducted by Addley and Peterson (2011). They assessed the relationship between incubation flows and spawning flows in their Table 5. Based on their spawning-incubation flow relationship and using the April mean flow for a year as the spawning flow and the June mean flow for the same year as the most limiting incubation flow, incubation success averaged 88% with a median of 95% during 1891-2011 and more recently averaged 80.5% with a median of 85% during 1986-2011 (Table 1). The more relevant figure was for 1986-2011 (current conditions), although it is noteworthy that incubation success appears to have declined in more recent years compared to the longer term record.

WDFW proposes that instream flows for spring should not result in lower incubation success than during the 1986-2011 period. Thus, incubation success should average around 80-81% and, more importantly, have a median of no less than 85% and preferably 90%. If incubation successes are averaged over columns (spawning flows) in Addley and Peterson's (2011) Table 5, an incubation flow of about 6,500 cfs would equate to about 85% incubation success on average with a median incubation success of about 90%. Addley and Peterson (2011) also tabulated spawning area with flow in the highest quality spawning grounds where they observed spawning trout and that also peaked around 6,500 cfs (Figure 3). The convergence of these two indicators of suitable spawning and incubation habitat as a function of flow support the WDFW recommendation of 6,500 cfs for April 1-June 15.

The Hardin report (NHC and HD, 2004) and the Parametrix (2003a, b) reports identified rainbow trout spawning sites in the lower Spokane River at Peaceful Valley and Evergreen (Upper San Soucci). In addition, a large amount of rainbow spawning has been documented at the TJ Meenach Springs and Riverbend sites. However, we do not have data on the incubation flows or water levels needed to protect these redds at these sites. The greater extent of the Addley and Peterson (2011) report includes sites addressed by Hardin (NHC and HD, 2004) and Parametrix (2003a, b).

Table 1. Historical and potential incubation flows and incubation success rates based on evaluation of April and June monthly mean flows at USGS gauge 12422500 (Spokane River at Spokane) in conjunction with Table 5 from Addley and Peterson (2011).

Comparison of historical and potential incubation flows and success rates

<u>Historical period</u>	<u>Flow</u>	<u>% Incubation</u>
• Potential	9,000 cfs	95%
• Potential	8,000 cfs	91.3%
• 1891-2011	varied	88% (95)
• Potential	7,000 cfs	87.1%
• Potential	6,000 cfs	82.1%
• 1986-2011	varied	80.5% (85)
• Potential	5,000 cfs	76.2%
• Potential	4,000 cfs	70%

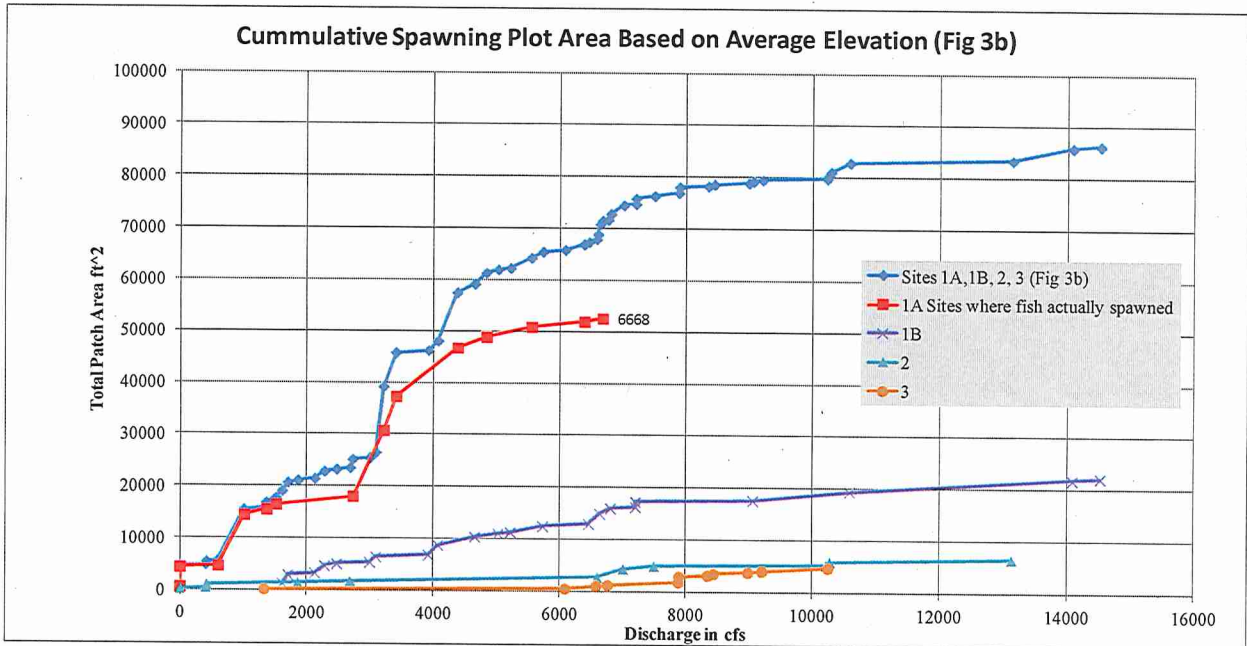


Figure 3. Cumulative rainbow trout spawning plot area reported by Addley and Peterson (2011) in their Figure 3b. Spawning areas were rated in quality from 1 (highest) to 3 (lowest) and highest quality sites were subdivided into those where trout spawned in 2010 (1A) and those where no spawning trout were seen in 2010 or 2003 (1B).

The proposed instream flows for all seasons are shown in Figure 4 in relation to 10-90% exceedence flows.

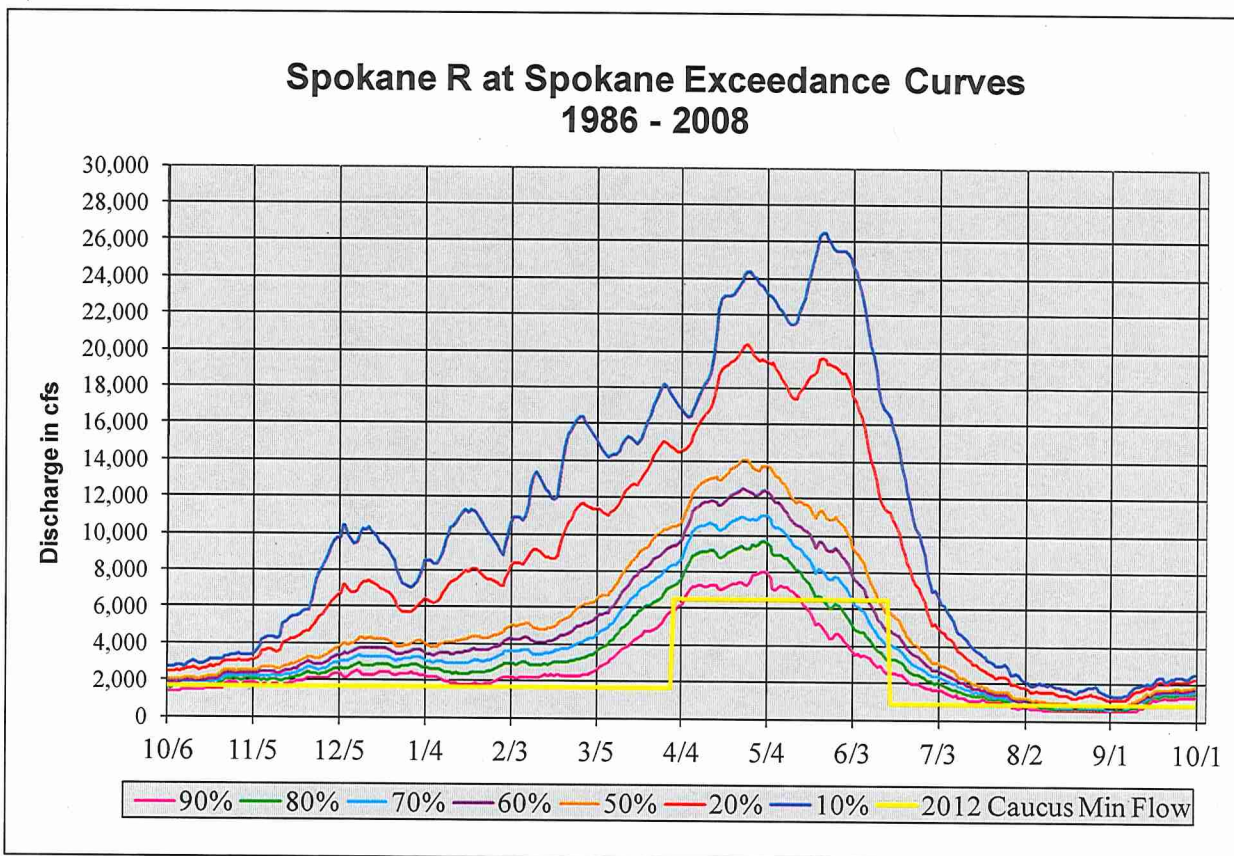


Figure 4. Exceedance hydrographs and recommended instream flows at USGS gauge 12422500 (Spokane River at Spokane).

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Literature Cited

Addley, R.C. and N.P. Peterson. 2011. Lower Spokane River Redband trout spawning habitat: Monroe Street Dam to Nine Mile Dam Pool. Spokane River Hydroelectric Project FERC Project No. 2545. Prepared for Avista Corp.

EES Consulting. 2007. *Final Technical Report – Spokane River Instream Flow Studies*. Prepared for Spokane County Public Works Department and WRIA 54 & 57 Watershed Planning Units. Bellingham, WA.

Little Spokane River and Middle Spokane River Planning Unit. 2006. Watershed Management Plan: Water Resources Inventory Area 55 – Little Spokane River & Water Resources Inventory Area 57 – Middle Spokane River. Spokane County, Spokane.
<http://www.spokanecounty.org/wqmp/projects/ASP/WatershedPlan.asp>

(NHC and HD) Northwest Hydraulic Consultants and Hardin-Davis, Inc. 2004. *Instream flow and fish habitat assessment – FERC Project No. 2545*, Avista Corporation. Corvallis, OR.

Parametrix. 2003a. *Rainbow trout radio-tracking survey 2003 – Interim Report. Spokane Hydroelectric Project, FERC Project No. 2545*. Prepared for Fisheries Work Group, Spokane River Project Relicensing, under contract to Avista Corporation, Spokane, WA. Parametrix, Kirkland, WA.

Parametrix. 2003b. *Rainbow trout spawning survey, 2003 – Final Report. Spokane Hydroelectric Project, FERC Project No. 2545*. Prepared for Fisheries Work Group, Spokane River Project Relicensing, under contract to Avista Corporation, Spokane, WA. Parametrix, Kirkland, WA.

Poff, N.L., J.D. Allan, M.B. Bain, J.R. Karr, K.L. Prestergaard, B. Richter, R. Sparks, and J. Stromberg. 1997. The natural flow regime: a paradigm for river conservation and restoration. *Bioscience* 47: 769-784.

Wydoski, R.S., and R.L. Whitney. 2003. *Inland fishes of Washington*. American Fisheries Society and University of Washington Press, Seattle and London. 322 pp.